Remarks/Arguments

Reconsideration of this application is requested.

Claim Status

Claims 9, 10, 12-14 and 17-20 were presented. Claims 9 and 12 are amended. New claims 33 and 34 are added. Thus, claims 9, 10, 12-14, 17-20, 33 and 34 are now pending.

Allowed Claims

The allowance of claims 10, 14 and 20 is noted and appreciated.

Claim Rejections – 35 USC 112 – First Paragraph

Claim 17 is rejected under 35 USC 112, first paragraph, as failing to comply with the written description requirement. The Action again asserts that claim 10, from which claim 17 depends, is directed to a first embodiment whose protrusions have surfaces including regions out of stoichiometric compositions and that there is no disclosure in the specification that the large protrusions of the first embodiment may be higher in height than small protrusions.

In response, Applicant again traverses the rejection and submits that the Examiner misconstrues "protrusions whose surfaces include regions out of stoichiometric compositions" as being limited solely to the first embodiment of Figs. 1-7. Protrusions 18 of both embodiments are formed by etching the surface of p-type GaN contact layer 16 using island-like AlGaN films 17 as a photomask (see page 14, lines 9-14 and page 19, lines 16-20). Formation of protrusions 18 on p-type contact layer 16 greatly reduces contact resistance between layer 16 and electrode 19, relative to the prior art (page 16, lines 17-20). The specification asserts two reasons for this reduction in contact resistance: (1) electrode materials enter into fine recesses 18c of protrusions 18 to increase contact areas (page 16, line 23 to page 17, line 2); and (2) there are regions in the outer layer of protrusions 18 where a group V element of nitrogen is lost and III-V crystalline structure is destroyed, i.e., there are "regions that are from stoichiometric compositions" (page 17, lines 4-8).

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Although the second reason for reduction in contact resistance - the formation of regions that are from stoichiometric compositions – is mentioned in the portion of the specification discussing embodiment 1 (Figs. 1-7), it is clear that such regions will also be formed in the second embodiment of Figs. 8A-D since the very same process of forming protrusions 18 is used: etching the surface of p-type GaN contact layer 16 using island-like AlGaN films 17 as a photomask. The second embodiment differs from the first embodiment in that a second round of photomasking and etching using island-like films 17a between and on top of protrusions 18 is employed. However, since this same process of photomasking and etching is noted as causing formation of the regions out of stoichiometric compositions in the first embodiment, it will be apparent to those of ordinary skill in the art that formation of such regions will of course also occur in the second embodiment.

The mere fact that description of this property is not repeated in the description of the second embodiment is of no consequence; it is clearly mentioned in the description of the first embodiment and is clearly shared by both embodiments since the same etching and photomasking process is used. The second embodiment is a variant of the first embodiment formed by the same core processes. In this regard, applicant notes that patent applications customarily do not repeat every single detail for embodiments that are similar to previously-described embodiments. The description usually focuses on the differences, as is the case here, and often does not repeat description of shared properties.

Thus, as asserted in the previous response, claim 10 covers both embodiments whereas dependent claim 17 introduces limitations that cover only the second embodiment (large protrusions higher in height than the small protrusions). Applicant strongly disagrees with the Examiner's continued insistence on this point, and requests that the Examiner specifically address the points made above in the next Action if this ground for rejection is maintained. Applicant made similar arguments in its previous response which the Examiner has still not addressed.

Claim Rejections – 35 USC 112 – Second Paragraph

Claims 9, 12, 13, 18 and 19 are rejected under 35 USC 112, second paragraph, as indefinite. In particular, the Action asserts that it is unclear what surface the phrase "the surface" refers to. In response, claims 9 and 12 are amended to clarify each instance of "surface".

In particular, claims 9 and 12 now recite that "fine recesses are formed on surfaces of the protrusions". In this regard, FIG. 5B clearly shows recesses 18c formed on surfaces of protrusion 18. The claims further recite "a first ohmic electrode formed on surfaces of the fine recesses and the protrusions". In this regard, page 17, lines 1-2 explains that electrode materials of electrode 19 enter into the recesses of the protrusions, and thus will clearly be formed on surfaces of the recesses and protrusions".

Thus, claims 9, 12, 13, 18 and 19 are clear, definite and in full compliance with 35 USC 112, second paragraph.

Claim Rejections – 35 USC 102 and 103

Claims 9, 12, 13, 18 and 19 are rejected under 35 USC 102(b) as anticipated by Hayashi (JP 2002-016312). Applicant respectfully traverses the rejections.

Page 3 of the Action again asserts that Hayashi discloses fine recesses formed in the protrusions formed in the bottom of layer 21. In support thereof, the Action relies on an enlarged, magnified reproduction of Hayashi's Fig. 7(f) and apparently takes the position that printing inconsistencies and variances in line quality, visible only under magnification, are equivalent to applicant's claimed and clearly disclosed fine recesses. Applicant strongly disagrees and asserts that such reasoning and grounds for rejection is improper. MPEP 2125 is directed to the use of drawings as prior art. In particular, MPEP 2125 recites:

> Drawings and pictures can anticipate claims if they *clearly* show the structure which is claimed. *In re Mraz,* 455 F.2d 1069, 173 USPQ 25 (CCPA 1972)... The drawings must be evaluated for what they reasonably disclose and suggest to one of ordinary

> skill in the art. *In re Aslanian,* 590 F.2d 911, 200 USPQ 500 (CCPA 1979).

Hayashi's FIG. 7(f) does not reasonably disclose and suggest to one of ordinary skill in the art applicant's claimed subject matter. The magnification of FIG. 7(f) produces unintended features and artifacts that are simply byproducts of exaggerated enlargement of a vague drawing figure. Hayashi never describes or suggests fine recesses formed on the bottom protrusions of substrate 21 in Fig. 7, or anywhere else. Applicant, by contrast, provides FIG. 5B and accompanying description which clearly illustrate and describe recesses 18c and the advantages they provide. Magnification and enlargement of Hayashi's vague figures to the point where artifacts and printing inconsistencies become visible that might be construed as a "recesses" is not a proper evaluation of those drawings for what they reasonably disclose or suggest to one of ordinary skill in the art, as is required by MPEP 2125 and the applicable case law. Instead, it is improper and illogical hindsight and reconstruction that would not be undertaken by anyone seeking to reasonably evaluate Hayashi's drawings and what they disclose or suggest.

Thus, for at least this reason, claims 9, 12, 13, 18 and 19 are not anticipated by Hayashi, and the rejections under 35 USC 102(b) should be withdrawn.

Moreover, the present invention is directed to a light emitting device that emits light from a first ohmic electrode. As shown in FIG. 7, light emitting diode (LED) 21 emits light from p-type electrode 19. Page 18, lines 7-26, further discloses that the fine recesses and protrusions increase optical output efficiency through light scattering effects. Claims 9 and 12 are amended to emphasize this distinctive feature by reciting that the first ohmic electrode is formed on the surfaces of the fine recesses and the protrusions, and that light is omitted by the first ohmic electrode.

In contrast, Hayashi is directed to a semiconductor laser diode that emits light in a single longitudinal mode (see Hayashi, paragraph [0093]). Laser light that is emitted in a longitudinal direction will not pass through uneven portions. In this regard, please see the enclosed copies of pages 268 and 269 from the publication

"SEMICONDUCTOR DEVICES Physics and Technology" which depict laser light emitted in a longitudinal direction. Therefore, the uneven portions of Hayashi will not provide light scattering effects which applicant provides to generate superior optical output efficiency. Even under the incorrect assumption that fine recesses are reasonably disclosed or suggested by Hayashi, the single longitudinal mode semiconductor laser of Hayashi does not function to scatter light.

Thus, for this additional reason, Hayashi does not disclose each and every feature of claims 9, 12, 13, 18 and 19, and the rejections under 35 USC 102(b) should accordingly be withdrawn.

New Claims

New claims 33-34 are added to better define the invention and are submitted to be allowable over the art of record.

Conclusion

This application is now believed to be in condition for allowance. The Examiner is invited to telephone the undersigned to resolve any issues that remain after entry of this amendment. Any fees due in connection with the filing of this response, please charge the fees to our Deposit Account No. 50-1314.

Respectfully submitted,
HOGAN & HARTSON L.L.P.

Date: October 13, 2006

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Reply to Office Action of July 13, 2006
Appendix

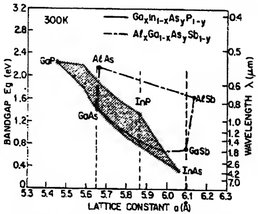

Fig. 16 Energy bandgap and lattice constant for two III–V compound solid alloy systems.[1]

the substrate, the quaternary compound $Ga_xIn_{1-x}As_yP_{1-y}$ also can have a nearly perfect lattice match, as indicated by the center vertical line in Fig. 16.

Figure 17*a* shows the bandgap of ternary $Al_xGa_{1-x}As$ as a function of aluminum composition.[1] The alloy has a direct bandgap up to $x = 0.45$, then becomes an indirect-bandgap semiconductor. Figure 17*b* shows the compositional dependence of the refractive index. For example, for $x = 0.3$, the bandgap of $Al_{0.3}Ga_{0.7}As$ is 1.789 eV, which is 0.365 eV larger than that of GaAs; its refractive index is 3.385, which is 6% smaller than that of GaAs. These properties are important for continuous operation of semiconductor lasers at and above room temperatures.

7.3.2 Laser Structures

Figure 18 shows three laser structures.[10] The first structure, Fig. 18*a*, is a basic *p–n* junction laser. This is called a *homojunction laser* because it has the same semiconductor material (e.g., GaAs) on both sides of the junction. A pair of parallel planes (or facets) are cleaved or polished perpendicular to the <110>-axis. Under appropriate biasing conditions, laser light will be emitted from these planes (only the front emission is shown in Fig. 18). The two remaining sides of the diode are roughened to eliminate lasing in the directions other than the main ones. This structure is called a *Fabry–Perot cavity*, with a typical cavity length L of about 300 μm. The Fabry–Perot cavity configuration is extensively used for modern semiconductor lasers.

Figure 18*b* shows a *double-heterostructure* (DH) laser, in which a thin layer of semiconductor (e.g., GaAs) is sandwiched between layers of a different semiconductor (e.g., $Al_xGa_{1-x}As$). This laser can be fabricated using epitaxial crystal growth techniques (refer to Chapter 8). We show in the subsequent section that a DH laser requires much less current to operate than a homojunction laser with identical device geometry.[11]

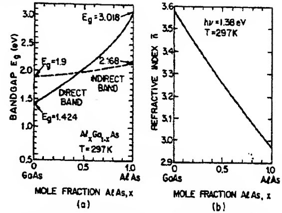

Fig. 17 (*a*) Compositional dependence of the $Al_xGa_{1-x}As$ energy gap.[1] (*b*) Compositional dependence of the refractive index at 1.38 eV.

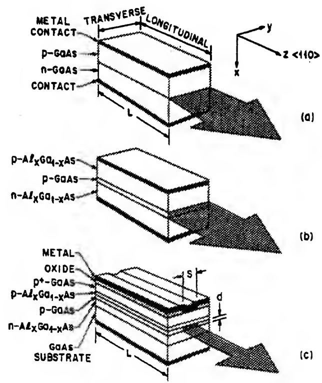

Fig. 18 Semiconductor laser structures in the Fabry–Perot–Cavity configuration. (*a*) Homojunction laser. (*b*) Double heterojunction (DH) laser. (c) Stripe geometry DH laser.[10, 11]

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